Stop A
Stanley Hotel
(Mountains)

Directions: *From the junction of Highway 34 and Highway 36 at the east end of Estes Park, proceed north about 0.2 mile to the entrance to the Stanley Historic District (Steamer Drive). Turn right on Steamer Drive and continue 150 feet to "T" intersection. Turn left (Service Entrance) and park immediately in the informal gravel parking area on the left.*

The view west over the town of Estes Park shows the jagged crest of the Continental Divide where it is crossed by Trail Ridge Road. The highest point on the road is just over 12,000 feet above sea level, and most of the peaks along the Divide are over 13,000 feet altitude. View to the south shows the dramatic summit of Longs Peak (14,255 feet altitude), the highest peak in the Front Range and the highest peak north of Interstate 70.

The rocks that make up Longs Peak and the other high summits in Rocky Mountain National Park are ancient gneisses, schists, and granites that originally formed far below the Earth's surface. Experimental laboratory evidence for rocks subjected to high temperatures and pressures suggests that these kinds of rocks were buried about 12 miles deep when they crystallized more than a billion years ago.

Younger sedimentary deposits in this region, called the Pierre Shale, contain marine fossils that were deposited in an ancient ocean basin. The Pierre Shale is now found at high altitudes in the western part of Rocky Mountain National Park (Never Summer Mountains at 13,000 feet) and beneath the High Plains (at 5,500 feet). The Pierre Shale indicates most of northern and eastern Colorado lay somewhat below sea level as recently as 70 million years ago.

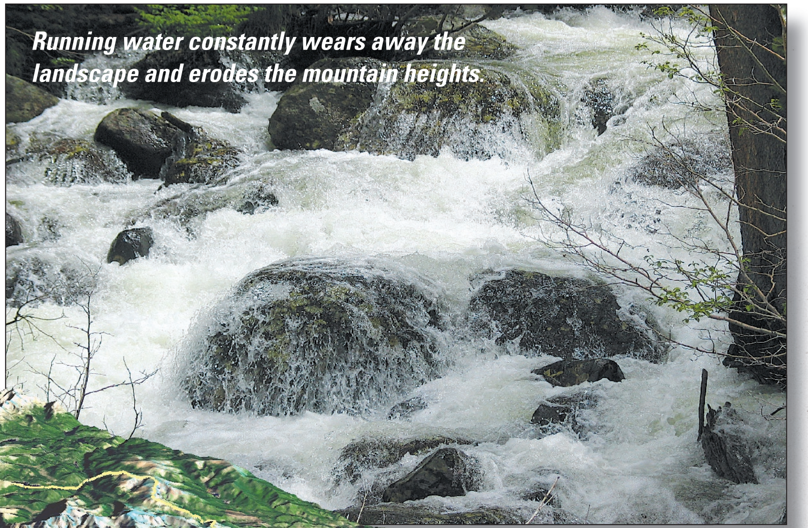
Right away, we face several questions. How did the ancient metamorphic rocks end up here, nearly 15 miles higher than where they formed? What caused the seas to retreat and raise the Pierre Shale more than 2 miles high? When did these mountains form? And perhaps the biggest question of all: Why are there mountains, anyway?

Almost every Earth process we observe around us works to bring down the mountains. Rain, melting snow, and streams carry sediment down from the heights toward the lowlands. Rockfalls and landslides move debris down toward the valleys. Wind carries silt and sand away from the heights. Glaciers flow down alpine valleys and carry away rubble from the valley sides and floors. Gravity and weathering operate day-in and day-out, year-in and year-out, over centuries and millennia, relentlessly eroding the peaks.

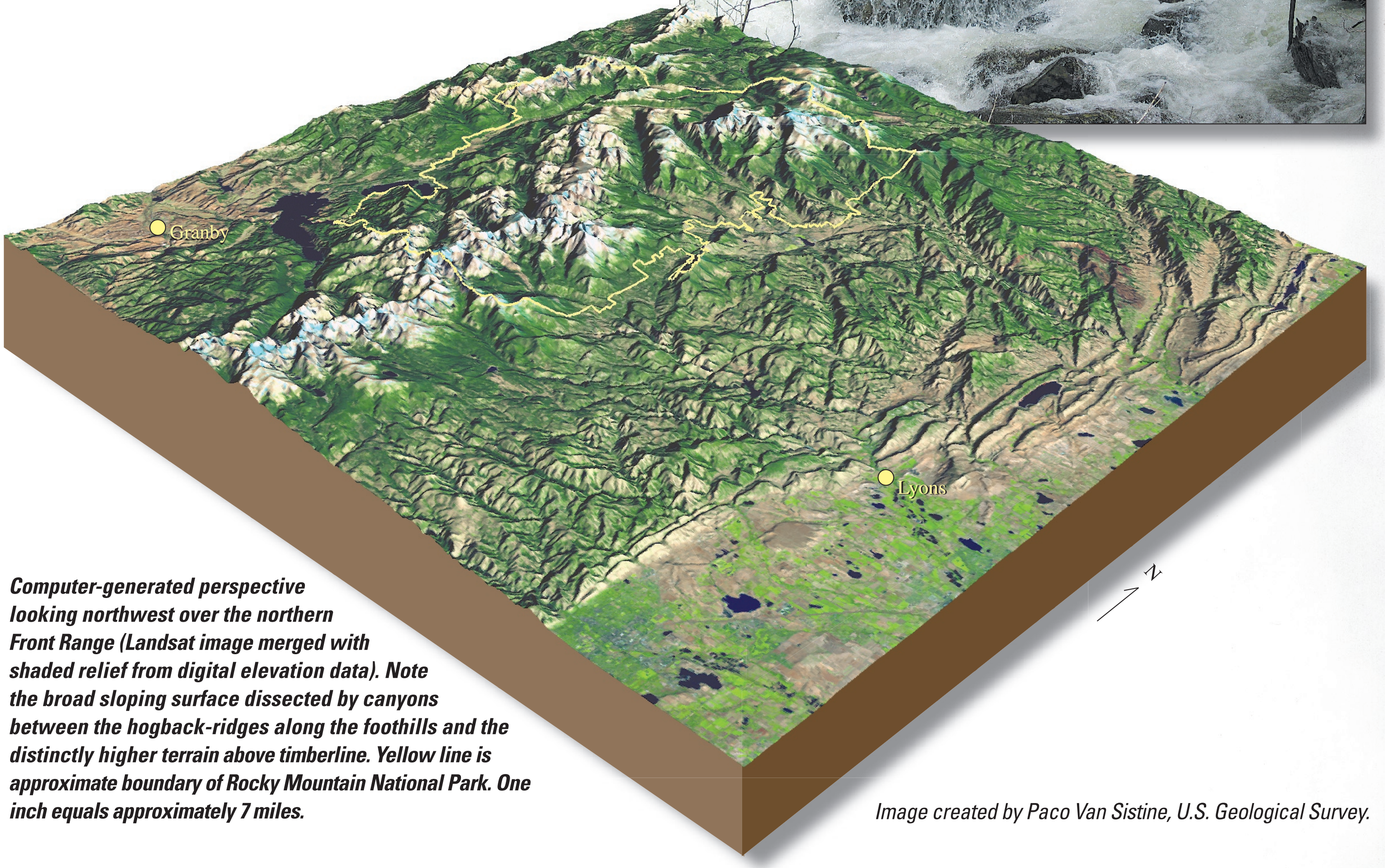
Longs Peak (14,259 feet) is the highest and most identifiable peak in Rocky Mountain National Park. Its broad, flat summit may be an uplifted remnant of an old Eocene erosion surface.

How fast does erosion happen? Suppose that all these processes had the effect of reducing the mountain altitudes by only one millimeter (about one-twenty-fifth of an inch) per year. That doesn't sound like much, but over geologic time it would reduce the mountain heights by about 10 centimeters (4 inches) in a century, one meter (39 inches) in a millennium, and 1,000 meters (3,300 feet, or nearly 0.6 mile) over a million years.

These mountains tell us that erosion is not the only process at work—UPLIFT also shapes the landscape. However, uplift is generally hard to observe on the human time scale because it happens slowly and it affects very broad areas.



Running water constantly wears away the landscape and erodes the mountain heights.



Computer-generated perspective looking northwest over the northern Front Range (Landsat image merged with shaded relief from digital elevation data). Note the broad sloping surface dissected by canyons between the hogback-ridges along the foothills and the distinctly higher terrain above timberline. Yellow line is approximate boundary of Rocky Mountain National Park. One inch equals approximately 7 miles.

Image created by Paco Van Sistine, U.S. Geological Survey.

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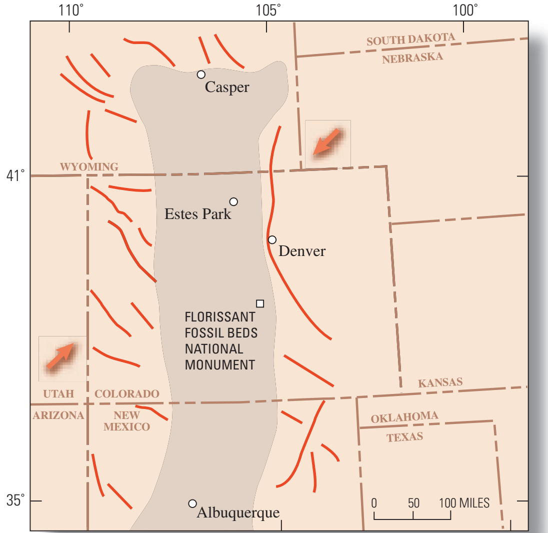


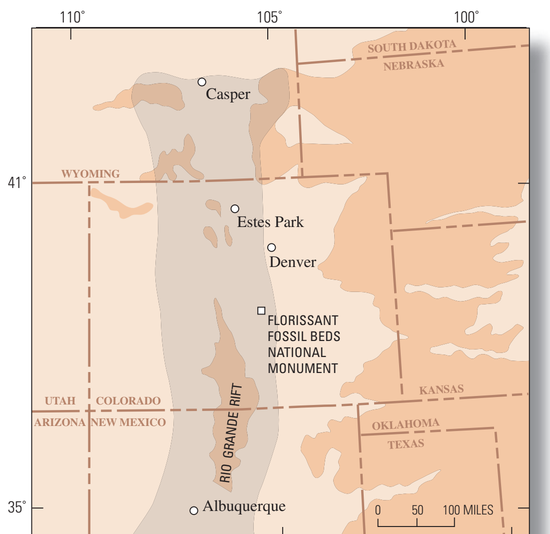
EXPLANATION

Area of younger uplift during the Miocene and Pliocene

Trends of Laramide block uplifts and crumpled folds

Direction of compression

Sketch map showing mostly northwest-southeast trends of block uplifts and crumpled folds that formed during the Laramide orogeny (70 to about 50 million years ago) during initial uplift of the Rocky Mountains. *Adapted from Eaton (1986).*



EXPLANATION

Sediments eroded from younger (Miocene-Pliocene) uplift of southern Rocky Mountains (15–5 million years ago)

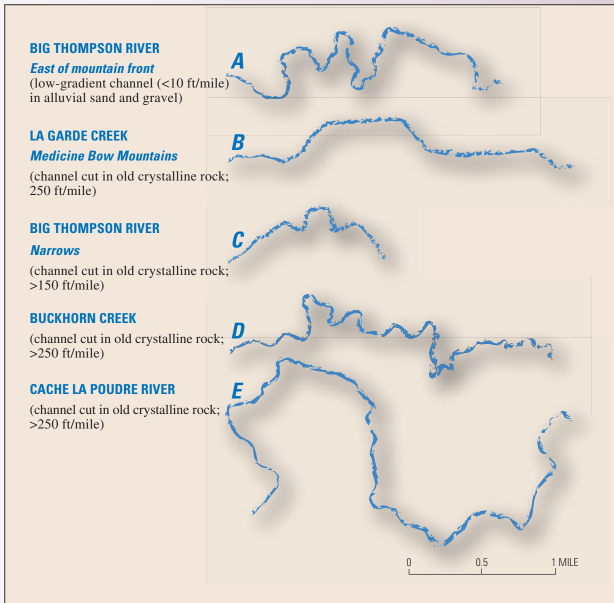
Area of younger uplift during the Miocene and Pliocene

Sketch map showing the north-south trend of the broad uplifted arch that defines the modern Southern Rocky Mountains that have risen in the last 15 million years. Sediments eroded from the rising Rockies were laid down in deposits that form broad, flanking slopes east of the mountain front, especially on the High Plains to the east. *Adapted from Eaton (1986).*

Geologists have learned that the Front Range uplift happened in two main phases. The first uplift took place at the end of the "age of dinosaurs" about 70 million years ago. The great inland sea (where the Pierre Shale was deposited) slowly withdrew to the Gulf of Mexico as the land rose by faulting and buckling in a long event called the "Laramide orogeny" ("oro-" = mountain; "-gene" = birth). Lakebeds preserved at Florissant Fossil Beds National Monument (about 100 miles south of Estes Park) were deposited in the uplifted and eroded terrain about 35 million years ago. They contain leaves and seeds of plants that probably grew at altitudes no greater than 3,000 feet above sea level. Such evidence suggests these Laramide-age mountains were probably never very tall.

Looking eastward over Lake Estes, you see no really high peaks east of Twin Sisters Mountain (the high ridge just left of Longs Peak). The gentler topography to the east reflects a broad upland surface that probably formed as the Laramide-age mountains were eroded and beveled at about the time the Florissant lakes existed. The streams and rivers active at that time had sinuous paths because they flowed on gently sloping surfaces. When the second uplift began about 15 million years ago, these sinuous river courses cut straight down into the solid crystalline rocks in the core of the range because they could not cut laterally against the hard rock. Most streams that drain the Front Range show these entrenched, meandering canyons that formed during the younger uplift.

This second uplift of the Front Range has the form of a broad, regional arch that can be traced from near El Paso, Texas, to Casper, Wyoming. It has a north-south trend that is different from the structural alignment of the earlier uplifts that formed in the Laramide orogeny. The central part of this arch was uplifted even more about 7–4 million years ago, which is why Colorado has so many peaks taller than 14,000 feet. Increased uplift led to increased erosion of the uplifted area, with deposition of sediments on the broad, flanking slopes east of the mountain front. The rate of uplift has been slower than erosion in the last 4 million years, and so the North and South Platte Rivers and their tributaries have steadily eroded broad valleys into these sediments.



Comparison of river courses (traced from maps at the same scale). Rivers that have low gradients (A) typically meander; medium- to high-gradient rivers (B) tend to have straighter courses. High-gradient rivers in the Front Range (C, D, E) show meandering valleys cut deep into hard rock, indicating they originally formed on a more gently sloping surface.